ABSTRACT

Project Title: Effects of Altered Rainfall Timing and Warming on Soil Processes and Plant Responses in a Grassland Ecosystem

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Temperature and precipitation are important climatic drivers for grasslands, making them particularly vulnerable to projected climate changes. For the Central Plains, mean temperatures are predicted to increase and precipitation patterns are expected to become more variable and extreme, with increased frequency of large precipitation events and extended droughts. Our research addresses these two important aspects of climate change, and their interactions, within a unique experimental facility capable of simultaneous manipulations of precipitation and temperature in an intact, native grassland. Our goals are (1) to determine how above- and belowground ecosystem characteristics respond to increases in ambient temperature and more extreme patterns of precipitation, and (2) to identify the consequences of these responses for grassland ecosystem function under an altered climate.

This research is being conducted at the Konza Prairie Biological Station (KPBS), an NSF-funded Long-Term Ecological Research site located in the Flint Hills of northeastern Kansas, and managed by Kansas State University.

Both warming and more extreme rainfall patterns (larger precipitation events with longer inter-rainfall droughts) will alter temporal patterns and depth distributions of soil moisture. Our central hypothesis is that plant, community and ecosystem attributes and processes in grasslands will respond to these spatio-temporal changes in resource availability. New measurements proposed here address specific hypotheses regarding the interactive effects of warming and altered rainfall timing on growing and dormant season soil CO_2 flux, root dynamics, the ability of plant and soil processes to recover following extended drought periods, changes in early and late season plant phenology and effects on ANPP and plant community composition, and the potential for increased N leaching under an altered climate.

Our approach utilizes a long-term field experiment in which rainfall timing and temperature are simultaneously manipulated in native grassland to determine how key ecosystem attributes and processes are altered by interactions between multiple climate change factors. We will conduct new measurements focused on belowground plant and ecosystem responses to complement our ongoing long-term studies, provide more detailed mechanistic explanations for observed soil and plant responses, and address potentially important non-growing season responses to the rainfall and heating treatments.

Deliverables include: data on belowground plant responses to altered growing season precipitation and mean annual temperature; data on patterns and annual rates of soil CO_2 flux; data on year-round changes in available soil N and soil solution chemistry; data sharing with related DOE projects; web dissemination of project results; and peer-reviewed publications and scientific presentations